

Mn-Zn Ferrite

# Material characteristics

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**Ferrite for switching power supplies**

**Ferrite for high-frequency power supplies**

**Large size ferrite for high power**

**Ferrite for telecommunication**

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**REMINDERS FOR USING THESE PRODUCTS**

Please be sure to read this manual thoroughly before using the products.

The products listed on this catalog are intended for use in general electronic equipment (AV equipment, telecommunications equipment, home appliances, amusement equipment, computer equipment, personal equipment, office equipment, measurement equipment, industrial robots) under a normal operation and use condition.

The products are not designed or warranted to meet the requirements of the applications listed below, whose performance and/or quality require a more stringent level of safety or reliability, or whose failure, malfunction or trouble could cause serious damage to society, person or property.

Please understand that we are not responsible for any damage or liability caused by use of the products in any of the applications below or for any other use exceeding the range or conditions set forth in this specification sheet.

If you intend to use the products in the applications listed below or if you have special requirements exceeding the range or conditions set forth in the each catalog, please contact us.

- |                                                                   |                                                                              |
|-------------------------------------------------------------------|------------------------------------------------------------------------------|
| (1) Aerospace/aviation equipment                                  | (9) Military equipment                                                       |
| (2) Transportation equipment (cars, electric trains, ships, etc.) | (10) Electric heating apparatus, burning equipment                           |
| (3) Medical equipment                                             | (11) Disaster prevention/crime prevention equipment                          |
| (4) Power-generation control equipment                            | (12) Safety equipment                                                        |
| (5) Atomic energy-related equipment                               | (13) Other applications that are not considered general-purpose applications |
| (6) Seabed equipment                                              |                                                                              |
| (7) Transportation control equipment                              |                                                                              |
| (8) Public information-processing equipment                       |                                                                              |

When using these products in general purposes and standard use, it is recommended that protection circuits are used, devices are secured, and backup circuits are kept for increased safety.

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# Mn-Zn Material list of ferrite for switching power supplies

## MATERIAL CHARACTERISTICS

| Material | Initial permeability<br><br>$\mu_i$ | Core loss volume density<br>(Core loss)*<br>P <sub>cv</sub><br><br>(kW/m <sup>3</sup> )<br>B=200mT<br>100kHz<br>sine wave |       |      |      | Saturation magnetic flux density*<br><br>B <sub>s</sub><br>(mT)<br>H=1194A/m |       |      |      | Remanent flux density*<br><br>B <sub>r</sub><br>(mT)<br>H=1194A/m |       |      |      | Coercive force*<br><br>H <sub>c</sub><br>(A/m)<br>H=1194A/m |       |     |   | Curie temperature<br><br>T <sub>c</sub><br>(°C) | Density*<br><br>d <sub>b</sub><br>(kg/m <sup>3</sup> )<br>×10 <sup>3</sup> | Electrical resistivity*<br><br>ρ <sub>v</sub><br>(Ω • m) |
|----------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------|------|------|------------------------------------------------------------------------------|-------|------|------|-------------------------------------------------------------------|-------|------|------|-------------------------------------------------------------|-------|-----|---|-------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------|
|          |                                     |                                                                                                                           |       |      |      |                                                                              |       |      |      |                                                                   |       |      |      |                                                             |       |     |   |                                                 |                                                                            |                                                          |
|          |                                     |                                                                                                                           |       |      |      |                                                                              |       |      |      |                                                                   |       |      |      |                                                             |       |     |   |                                                 |                                                                            |                                                          |
| 25°C     | 60°C                                | 100°C                                                                                                                     | 120°C | 25°C | 60°C | 100°C                                                                        | 120°C | 25°C | 60°C | 100°C                                                             | 120°C | 25°C | 60°C | 100°C                                                       | 120°C |     |   |                                                 |                                                                            |                                                          |
| PC47     | 2500±25%                            | 600                                                                                                                       | 400   | 250  | 360  | 530                                                                          | 480   | 420  | 390  | 180                                                               | 100   | 60   | 60   | 13                                                          | 9     | 6   | 7 | >230                                            | 4.9                                                                        | 4                                                        |
| PC90     | 2200±25%                            | 680                                                                                                                       | 470   | 320  | 460  | 540                                                                          | 500   | 450  | 420  | 170                                                               | 95    | 60   | 65   | 13                                                          | 9     | 6.5 | 7 | >250                                            | 4.9                                                                        | 4                                                        |
| PC95     | 3300±25%                            | 350                                                                                                                       |       | 290  | 350  | 530                                                                          | 480   | 410  | 380  | 85                                                                | 70    | 60   | 55   | 9.5                                                         | 7.5   | 6.5 | 6 | >215                                            | 4.9                                                                        | 6                                                        |

\* Typ.

| Material | Initial permeability<br>$\mu_i$     | Relative loss factor*<br><br>tanδ/μi<br>×10 <sup>-6</sup> | Saturation magnetic flux density*<br><br>B <sub>s</sub><br>(mT)<br>H=1194A/m<br>25°C | Remanent flux density*<br><br>B <sub>r</sub><br>(mT)<br>H=1194A/m<br>25°C | Coercive force*<br><br>H <sub>c</sub><br>(A/m)<br>H=1194A/m<br>25°C | Curie temperature<br><br>T <sub>c</sub><br>(°C) | Density*<br><br>d <sub>b</sub><br>(kg/m <sup>3</sup> )<br>×10 <sup>3</sup> | Electrical resistivity*<br><br>ρ <sub>v</sub><br>(Ω • m) |
|----------|-------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------|
|          |                                     |                                                           |                                                                                      |                                                                           |                                                                     |                                                 |                                                                            |                                                          |
| HS72     | 7500±25%<br>(2000min.<br>at 500kHz) | 30(100kHz)                                                | 430                                                                                  | 55                                                                        | 4                                                                   | >130                                            | 4.9                                                                        | 0.2                                                      |
| HS10     | 10000±25%                           | 30(100kHz)                                                | 400                                                                                  | 70                                                                        | 3                                                                   | >120                                            | 4.9                                                                        | 0.2                                                      |

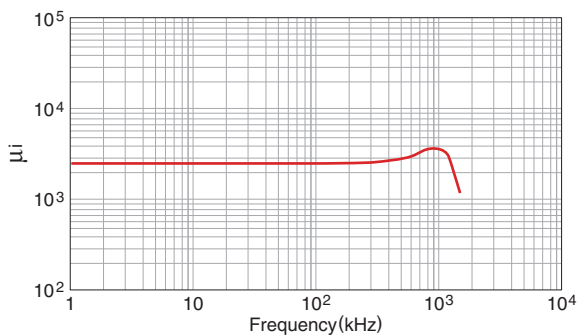
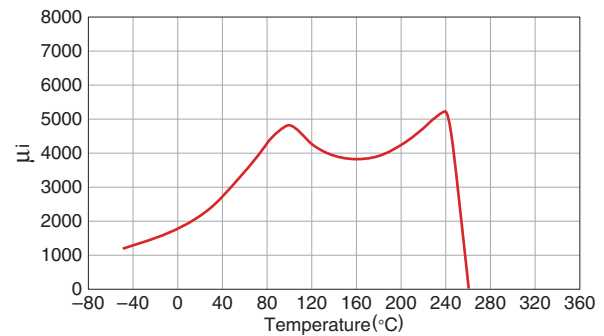
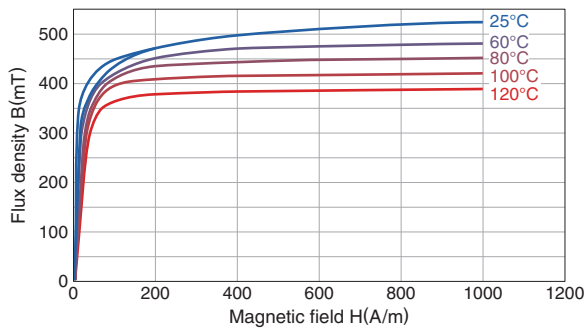
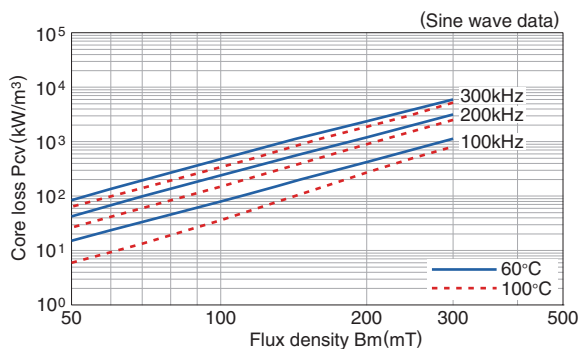
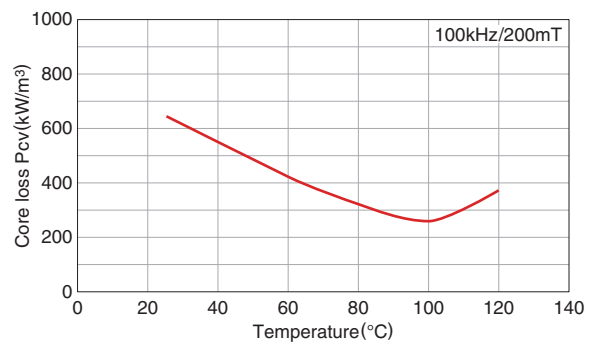
\* Typ.

Background yellow: The products which are not recommended to a new design.

Mn-Zn Ferrite for switching power supplies **Material list of PC47****MATERIAL CHARACTERISTICS**

| Initial permeability<br>$\mu_i$ | Core loss volume density<br>(Core loss)*<br>$P_{cv}$<br>(kW/m <sup>3</sup> )<br>B=200mT<br>100kHz<br>sine wave |      |       |       | Saturation magnetic flux density*<br>$B_s$<br>(mT)<br>H=1194A/m |      |       |       | Remanent flux density*<br>$B_r$<br>(mT)<br>H=1194A/m |      |       |       | Coercive force*<br>$H_c$<br>(A/m)<br>H=1194A/m |      |       |       | Curie temperature<br>$T_c$<br>(°C) | Density*<br>$\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | Electrical resistivity*<br>$\rho_v$<br>( $\Omega \cdot m$ ) |
|---------------------------------|----------------------------------------------------------------------------------------------------------------|------|-------|-------|-----------------------------------------------------------------|------|-------|-------|------------------------------------------------------|------|-------|-------|------------------------------------------------|------|-------|-------|------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------|
|                                 | 25°C                                                                                                           | 60°C | 100°C | 120°C | 25°C                                                            | 60°C | 100°C | 120°C | 25°C                                                 | 60°C | 100°C | 120°C | 25°C                                           | 60°C | 100°C | 120°C |                                    |                                                               |                                                             |
| 2500 $\pm$ 25%                  | 600                                                                                                            | 400  | 250   | 360   | 530                                                             | 480  | 420   | 390   | 180                                                  | 100  | 60    | 60    | 13                                             | 9    | 6     | 7     | >230                               | 4.9                                                           | 4                                                           |

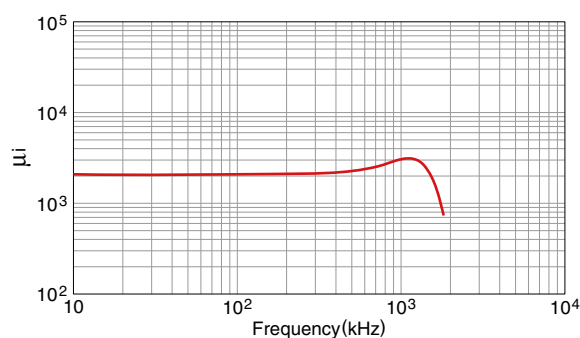
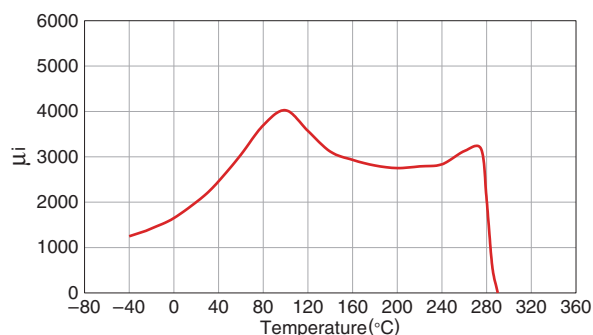
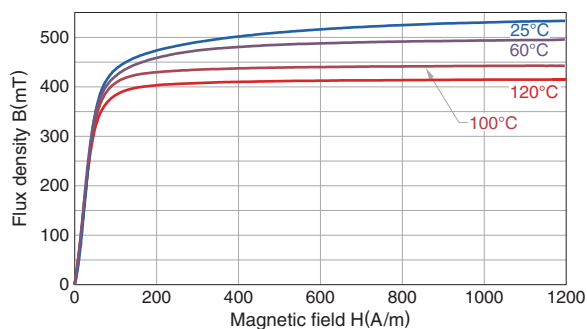
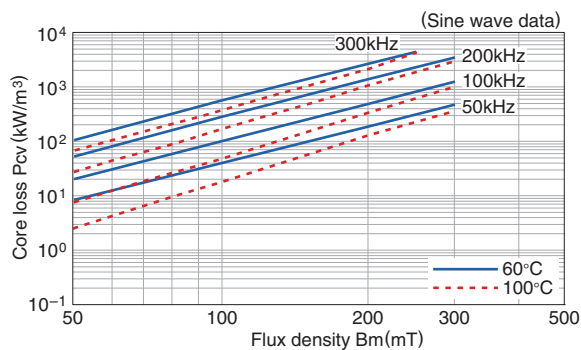
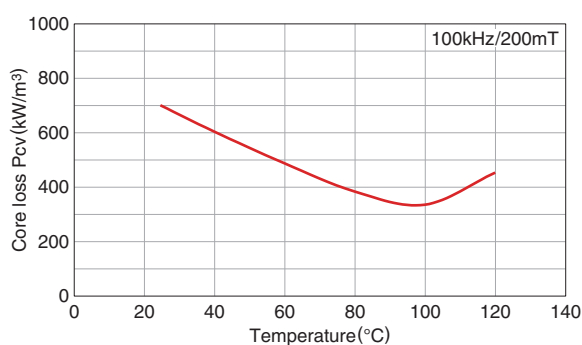
\* Typ.

 **$\mu_i$  frequency characteristics (Typ.)** **$\mu_i$  temperature characteristics (Typ.)****B-H temperature characteristics (Typ.)****Core loss (Typ.)****Temperature dependence of core loss (Typ.)**

Mn-Zn Ferrite for switching power supplies **Material list of PC90****MATERIAL CHARACTERISTICS**

| Initial permeability<br>$\mu_i$ | Core loss volume density<br>(Core loss)*<br>$P_{cv}$<br>(kW/m <sup>3</sup> )<br>B=200mT<br>100kHz<br>sine wave |      |       |       | Saturation magnetic<br>flux density*<br>$B_s$<br>(mT)<br>H=1194A/m |      |       |       | Remanent flux<br>density*<br>$B_r$<br>(mT)<br>H=1194A/m |      |       |       | Coercive force*<br>$H_c$<br>(A/m)<br>H=1194A/m |      |       |       | Curie temperature<br>$T_c$<br>(°C) | Density*<br>$\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | Electrical resistivity*<br>$\rho_v$<br>( $\Omega \cdot m$ ) |
|---------------------------------|----------------------------------------------------------------------------------------------------------------|------|-------|-------|--------------------------------------------------------------------|------|-------|-------|---------------------------------------------------------|------|-------|-------|------------------------------------------------|------|-------|-------|------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------|
|                                 | 25°C                                                                                                           | 60°C | 100°C | 120°C | 25°C                                                               | 60°C | 100°C | 120°C | 25°C                                                    | 60°C | 100°C | 120°C | 25°C                                           | 60°C | 100°C | 120°C |                                    |                                                               |                                                             |
| 2200 $\pm$ 25%                  | 680                                                                                                            | 470  | 320   | 460   | 540                                                                | 500  | 450   | 420   | 170                                                     | 95   | 60    | 65    | 13                                             | 9    | 6.5   | 7     | >250                               | 4.9                                                           | 4                                                           |

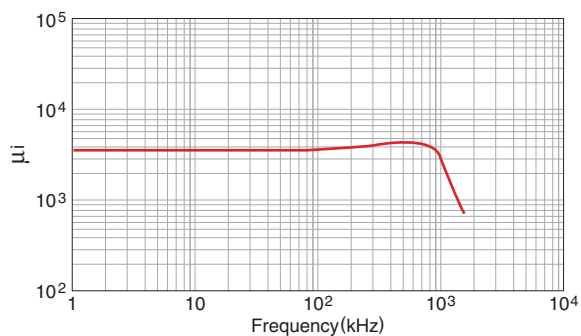
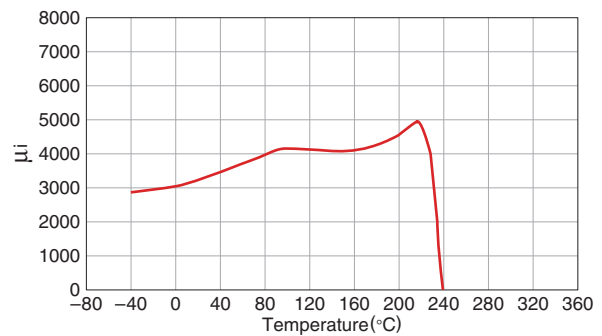
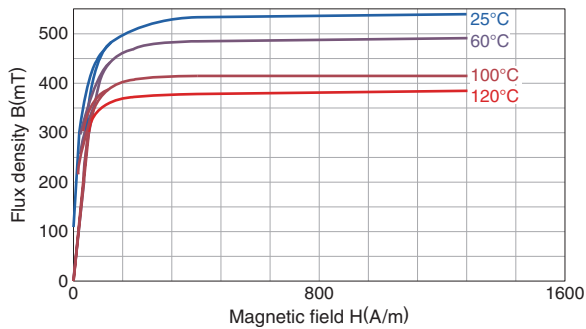
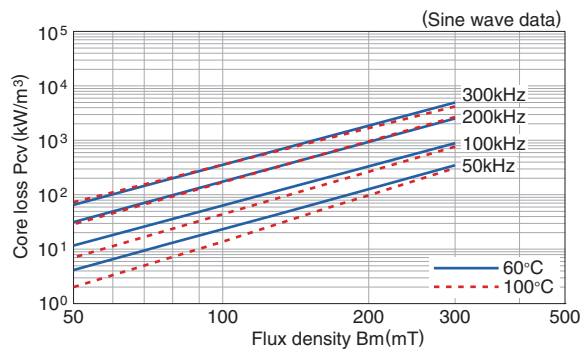
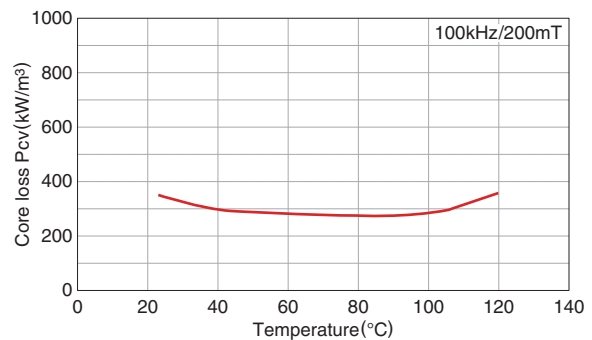
\* Typ.

 **$\mu_i$  frequency characteristics (Typ.)** **$\mu_i$  temperature characteristics (Typ.)****B-H temperature characteristics (Typ.)****Core loss (Typ.)****Temperature dependence of core loss (Typ.)**

Mn-Zn Ferrite for switching power supplies **Material list of PC95****MATERIAL CHARACTERISTICS**

| Initial permeability<br>$\mu_i$ | Core loss volume density<br>(Core loss)*<br>$P_{cv}$<br>(kW/m <sup>3</sup> )<br>B=200mT<br>100kHz<br>sine wave |      |       |       | Saturation magnetic flux density*<br>$B_s$<br>(mT)<br>H=1194A/m |      |       |       | Remanent flux density*<br>$B_r$<br>(mT)<br>H=1194A/m |      |       |       | Coercive force*<br>$H_c$<br>(A/m)<br>H=1194A/m |      |       |       | Curie temperature<br>$T_c$<br>(°C) | Density*<br>$\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | Electrical resistivity*<br>$\rho_v$<br>( $\Omega \cdot m$ ) |
|---------------------------------|----------------------------------------------------------------------------------------------------------------|------|-------|-------|-----------------------------------------------------------------|------|-------|-------|------------------------------------------------------|------|-------|-------|------------------------------------------------|------|-------|-------|------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------|
|                                 | 25°C                                                                                                           | 60°C | 100°C | 120°C | 25°C                                                            | 60°C | 100°C | 120°C | 25°C                                                 | 60°C | 100°C | 120°C | 25°C                                           | 60°C | 100°C | 120°C |                                    |                                                               |                                                             |
| 3300 $\pm$ 25%                  | 350                                                                                                            |      | 290   | 350   | 530                                                             | 480  | 410   | 380   | 85                                                   | 70   | 60    | 55    | 9.5                                            | 7.5  | 6.5   | 6     | >215                               | 4.9                                                           | 6                                                           |

\* Typ.

 **$\mu_i$  frequency characteristics (Typ.)** **$\mu_i$  temperature characteristics (Typ.)****B-H temperature characteristics (Typ.)****Core loss (Typ.)****Temperature dependence of core loss (Typ.)**

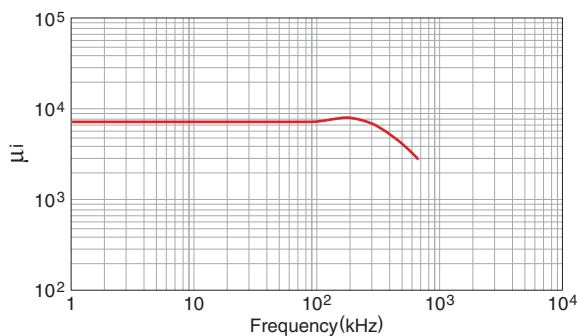
# Mn-Zn Ferrite for switching power supplies **Material list of HS72**

## MATERIAL CHARACTERISTICS

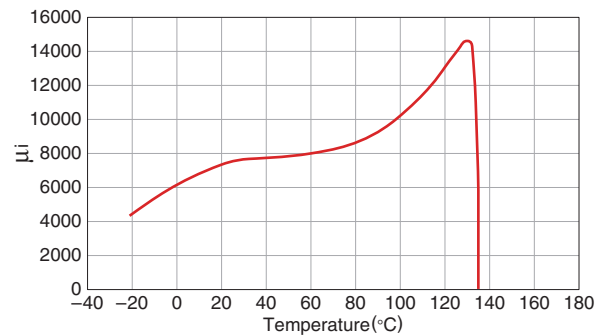
| Initial permeability<br>$\mu_i$           | Relative loss factor*<br>$\tan\delta/\mu_i$<br>$\times 10^{-6}$ | Saturation magnetic flux density*<br>Bs<br>(mT)<br>H=1194A/m<br>25°C | Remanent flux density*<br>Br<br>(mT)<br>H=1194A/m<br>25°C | Coercive force*<br>Hc<br>(A/m)<br>H=1194A/m<br>25°C | Curie temperature<br>Tc<br>(°C) | Density*<br>db<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | Electrical resistivity*<br>$\rho_v$<br>( $\Omega \cdot m$ ) |
|-------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------|---------------------------------|---------------------------------------------------------|-------------------------------------------------------------|
| 7500 $\pm$ 25%<br>(2000min.<br>at 500kHz) | 30(100kHz)                                                      | 430                                                                  | 55                                                        | 4                                                   | >130                            | 4.9                                                     | 0.2                                                         |

\* Typ.

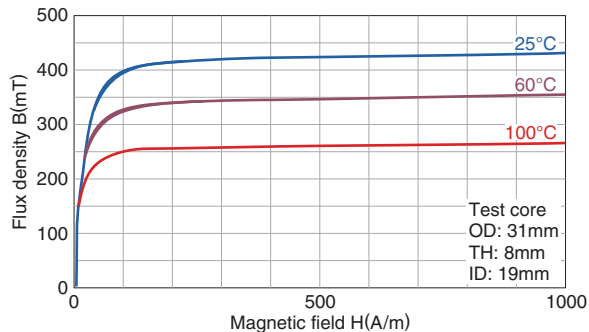
### $\mu_i$ frequency characteristics (Typ.)



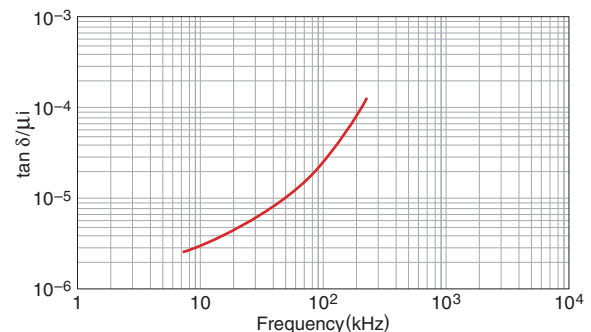
### $\mu_i$ temperature characteristics (Typ.)



### B-H temperature characteristics (Typ.)



### $\tan\delta/\mu_i$ frequency characteristics (Typ.)



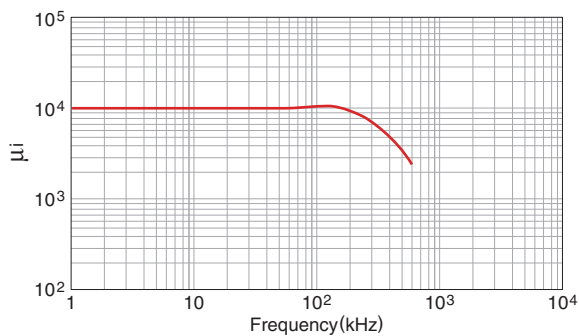
# Mn-Zn Ferrite for switching power supplies **Material list of HS10**

## MATERIAL CHARACTERISTICS

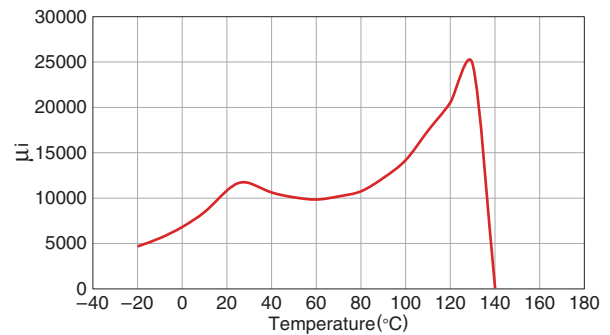
| Initial permeability<br>$\mu_i$ | Relative loss factor*<br>$\tan\delta/\mu_i$<br>$\times 10^{-6}$ | Saturation magnetic flux density*<br>$B_s$<br>(mT)<br>H=1194A/m<br>25°C | Remanent flux density*<br>$B_r$<br>(mT)<br>H=1194A/m<br>25°C | Coercive force*<br>$H_c$<br>(A/m)<br>H=1194A/m<br>25°C | Curie temperature<br>$T_c$<br>(°C) | Density*<br>$\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | Electrical resistivity*<br>$\rho_v$<br>( $\Omega \cdot m$ ) |
|---------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------|------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------|
| 10000 $\pm$ 25%                 | 30(100kHz)                                                      | 400                                                                     | 70                                                           | 3                                                      | >120                               | 4.9                                                           | 0.2                                                         |

\* Typ.

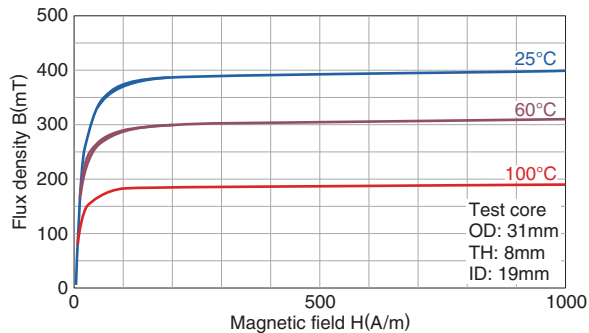
### $\mu_i$ frequency characteristics (Typ.)



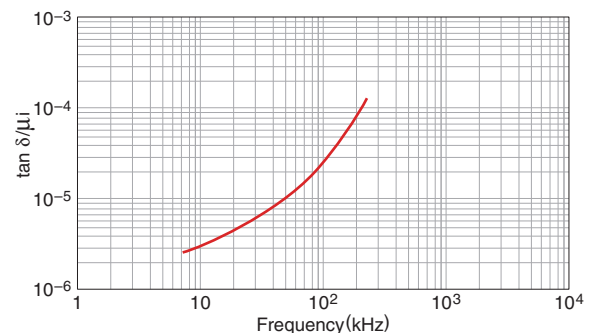
### $\mu_i$ temperature characteristics (Typ.)



### B-H temperature characteristics (Typ.)



### $\tan\delta/\mu_i$ frequency characteristics (Typ.)



Mn-Zn **Material list of ferrite for high-frequency power supplies**

## ■ MATERIAL CHARACTERISTICS

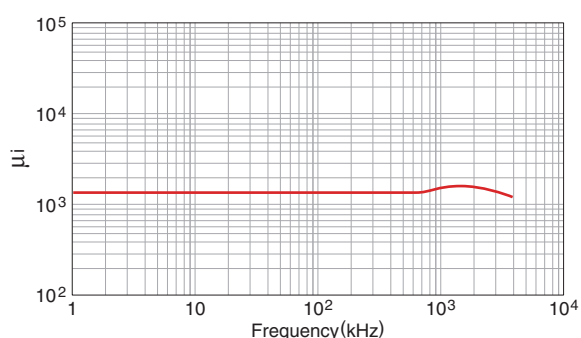
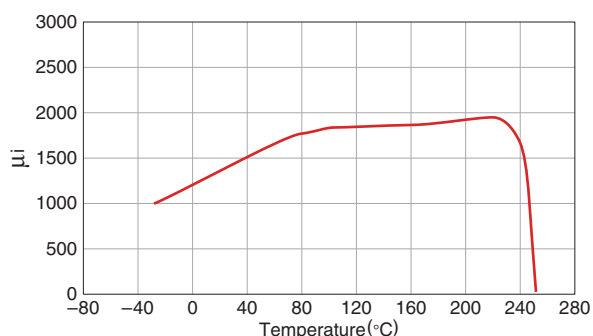
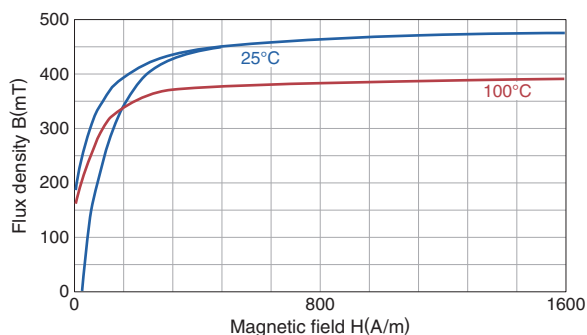
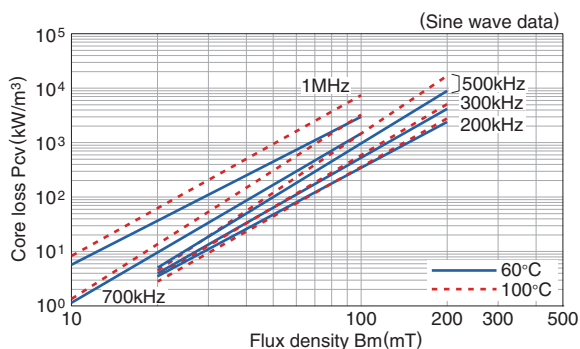
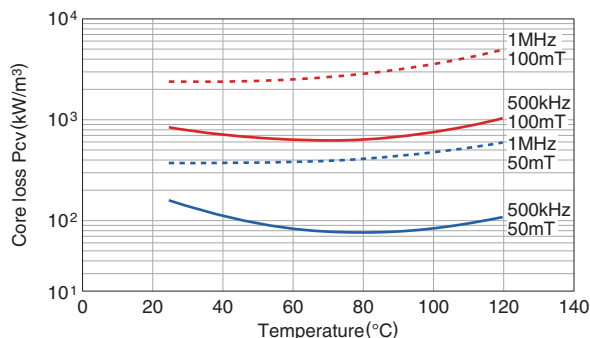
| Material | Initial permeability<br><br>μi | Core loss volume density<br>(Core loss)*<br><br>Pcv<br>(kW/m³)<br>sine wave |       |                |       |                |       | Saturation magnetic flux density*<br>Bs<br>(mT)<br>H=1194A/m |       | Remanent flux density*<br>Br<br>(mT)<br>H=1194A/m |       | Coercive force*<br>Hc<br>(A/m)<br>H=1194A/m |       | Curie temperature<br>Tc<br>(°C) | Density*<br>db<br>(kg/m³)<br>×10³ | Electrical resistivity*<br><br>(Ω • m) |
|----------|--------------------------------|-----------------------------------------------------------------------------|-------|----------------|-------|----------------|-------|--------------------------------------------------------------|-------|---------------------------------------------------|-------|---------------------------------------------|-------|---------------------------------|-----------------------------------|----------------------------------------|
|          |                                | 500kHz<br>B=50mT                                                            |       | 1MHz<br>B=50mT |       | 2MHz<br>B=30mT |       |                                                              |       |                                                   |       |                                             |       |                                 |                                   |                                        |
|          |                                | 25°C                                                                        | 100°C | 25°C           | 100°C | 25°C           | 100°C | 25°C                                                         | 100°C | 25°C                                              | 100°C | 25°C                                        | 100°C |                                 |                                   |                                        |
|          |                                |                                                                             |       |                |       |                |       |                                                              |       |                                                   |       |                                             |       |                                 |                                   |                                        |
| PC50     | 1400±25%                       | 130                                                                         | 80    |                |       |                |       | 470                                                          | 380   | 140                                               | 98    | 37                                          | 27    | >240                            | 4.8                               | 30                                     |
| PC200    | 800±25%                        |                                                                             |       | 145            | 180   | 160            | 200   | 485                                                          | 410   | 141                                               | 144   | 51                                          | 48    | >280                            | 4.9                               | 22                                     |

\* Typ.

Mn-Zn Ferrite for high-frequency power supplies **Material list of PC50****MATERIAL CHARACTERISTICS**

| Initial permeability<br>$\mu_i$ | Core loss volume density<br>(Core loss)*<br>$P_{cv}$<br>(kW/m <sup>3</sup> )<br>sine wave<br>500kHz<br>B=50mT |       | Saturation magnetic<br>flux density*<br>$B_s$<br>(mT)<br>H=1194A/m |       | Remanent flux<br>density*<br>$B_r$<br>(mT)<br>H=1194A/m |       | Coercive force*<br>$H_c$<br>(A/m)<br>H=1194A/m |       | Curie temperature<br>$T_c$<br>(°C) | Density*<br>$\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | Electrical resistivity*<br>( $\Omega \cdot m$ ) |
|---------------------------------|---------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------|-------|---------------------------------------------------------|-------|------------------------------------------------|-------|------------------------------------|---------------------------------------------------------------|-------------------------------------------------|
| 1400 $\pm$ 25%                  | 25°C                                                                                                          | 100°C | 25°C                                                               | 100°C | 25°C                                                    | 100°C | 25°C                                           | 100°C |                                    |                                                               |                                                 |
|                                 | 130                                                                                                           | 80    | 470                                                                | 380   | 140                                                     | 98    | 37                                             | 27    | >240                               | 4.8                                                           | 30                                              |

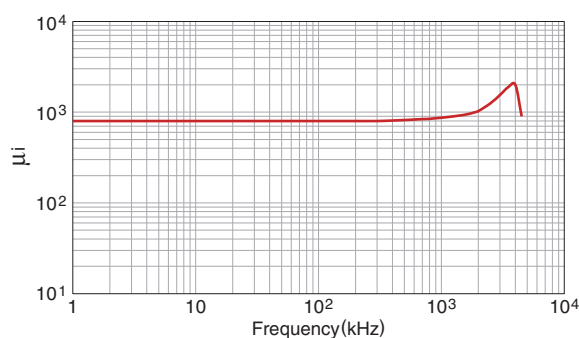
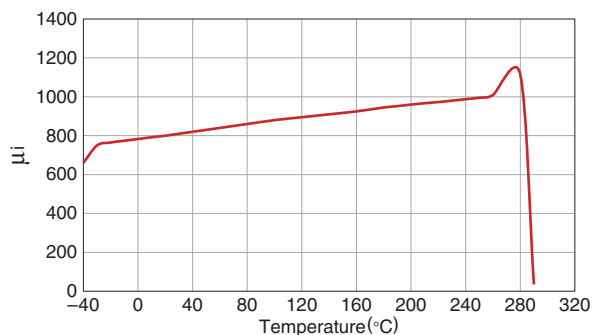
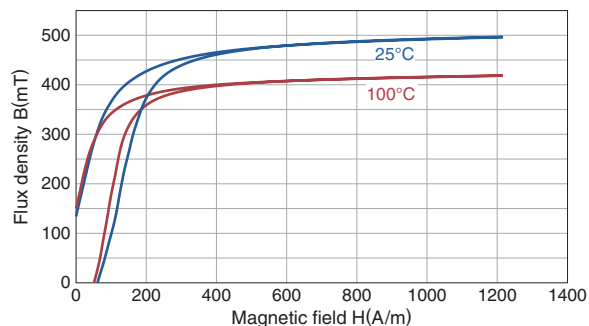
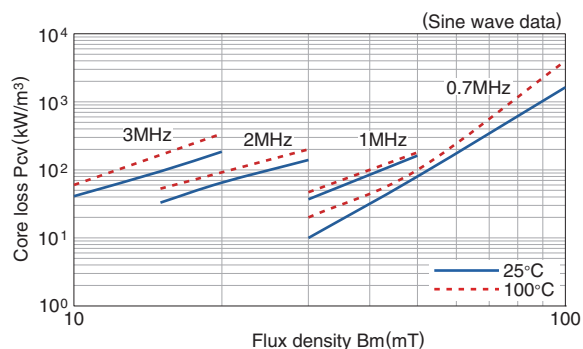
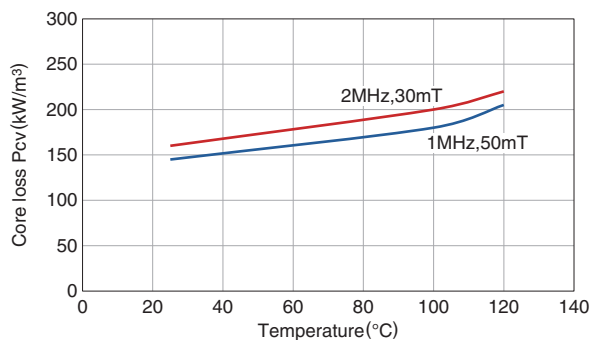
\* Typ.

 **$\mu_i$  frequency characteristics (Typ.)** **$\mu_i$  temperature characteristics (Typ.)****B-H temperature characteristics (Typ.)****Core loss (Typ.)****Temperature dependence of core loss (Typ.)**

Mn-Zn Ferrite for high-frequency power supplies **Material list of PC200****MATERIAL CHARACTERISTICS**

| Initial permeability<br>$\mu_i$ | Core loss volume density<br>(Core loss)*<br>$P_{cv}$<br>(kW/m <sup>3</sup> )<br>sine wave |     |                         |     | Saturation magnetic<br>flux density*<br>$B_s$<br>(mT)<br>$H=1194\text{A/m}$ |       | Remanent<br>flux density*<br>$B_r$<br>(mT)<br>$H=1194\text{A/m}$ |       | Coercive force*<br>$H_c$<br>(A/m)<br>$H=1194\text{A/m}$ |       | Curie temperature<br>$T_c$<br>(°C) | Density*<br>$\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | Electrical resistivity*<br>( $\Omega \cdot \text{m}$ ) |
|---------------------------------|-------------------------------------------------------------------------------------------|-----|-------------------------|-----|-----------------------------------------------------------------------------|-------|------------------------------------------------------------------|-------|---------------------------------------------------------|-------|------------------------------------|---------------------------------------------------------------|--------------------------------------------------------|
|                                 | 1MHz<br>$B=50\text{mT}$                                                                   |     | 2MHz<br>$B=30\text{mT}$ |     | 25°C                                                                        | 100°C | 25°C                                                             | 100°C | 25°C                                                    | 100°C |                                    |                                                               |                                                        |
| 800±25%                         | 145                                                                                       | 180 | 160                     | 200 | 485                                                                         | 410   | 141                                                              | 144   | 51                                                      | 48    | >280                               | 4.9                                                           | 22                                                     |

\* Typ.

 **$\mu_i$  frequency characteristics (Typ.)** **$\mu_i$  temperature characteristics (Typ.)****B-H temperature characteristics (Typ.)****Core loss (Typ.)****Temperature dependence of core loss (Typ.)**

# Mn-Zn Ferrite for high-frequency power supplies **Material list of PC200**

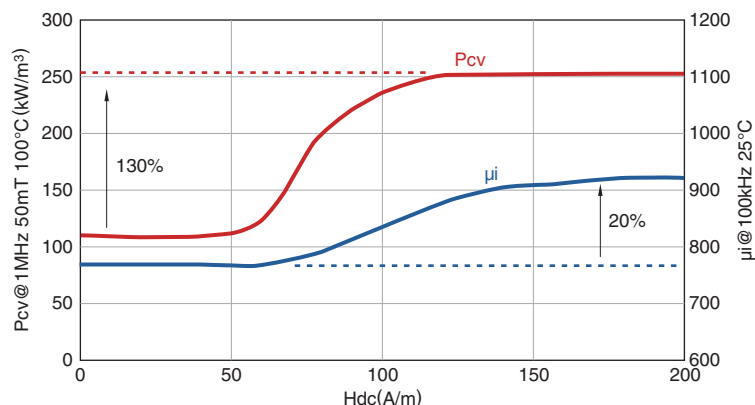
## ■ PRECAUTIONS FOR USE OF PC200 MATERIALS

The characteristics of the PC200 material change as follows depending on the application of a DC magnetic field such as a magnet or the magnitude of the applied magnetic field ( $H_{dc}$ ) at the time of use.

The characteristics of the PC200 material are changed as follows in the reliability test.

PC200 material recommends use by a little low magnetic field of a special quality change.

### □ Characteristic change due to applied magnetic field \*



| Characteristic change due to applied magnetic field | Change rate (Typ.) |
|-----------------------------------------------------|--------------------|
| Pcv at 1MHz, 50mT, 100°C                            | +130%              |
| $\mu_i$ at 100kHz, 25°C                             | +20%               |

### □ Reliability test results \*

| Characteristics change by thermal shock test | Change rate (Typ.) |
|----------------------------------------------|--------------------|
| Pcv at 1MHz, 50mT, 100°C                     | -18%               |
| $\mu_i$ at 100kHz, 25°C                      | -7%                |

Test conditions: -40 ~ 125°C. 1000 cycles. Exposure time = 30 minutes

| Characteristic changes due to high temperature storage tests | Change rate (Typ.) |
|--------------------------------------------------------------|--------------------|
| Pcv at 1MHz, 50mT, 100°C                                     | -32%               |
| $\mu_i$ at 100kHz, 25°C                                      | -14%               |

Test conditions: 125±2°C. Retention time = 2000 hours

| Characteristic changes due to low temperature storage tests | Change rate (Typ.) |
|-------------------------------------------------------------|--------------------|
| Pcv at 1MHz, 50mT, 100°C                                    | ±5% max.           |
| $\mu_i$ at 100kHz, 25°C                                     | ±5% max.           |

Test conditions: -40±3°C. Retention time = 2000 hours

| Characteristics change by humidity endurance tests | Change rate (Typ.) |
|----------------------------------------------------|--------------------|
| Pcv at 1MHz, 50mT, 100°C                           | ±5% max.           |
| $\mu_i$ at 100kHz, 25°C                            | ±5% max.           |

Test conditions: 60±2°C, 90-95%R.H.(Ⅲ) Retention time = 2000 hours

\*Evaluated by toroidal shape Pcv: Core loss  $\mu_i$ : Initial permeability

Mn-Zn **Material list of large size ferrite for high power**

## ■ MATERIAL CHARACTERISTICS

| Material | Initial permeability*<br>$\mu_i$ | Curie temperature<br>$T_c$<br>(°C) | Saturation magnetic flux density*<br>$B_s$<br>(mT)<br>$H=1194\text{A/m}$ |       | Remanent flux density*<br>$B_r$<br>(mT) | Coercive force*<br>$H_c$<br>(A/m) | Core loss*<br>$P_{cv}$<br>(kW/m <sup>3</sup> )<br>$B=200\text{mT}$ |              |              | Electrical resistivity*<br>$\rho$<br>( $\Omega \cdot \text{m}$ ) | Approximate density*<br>$d_{app}$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | Thermal expansion coefficient*<br>$\alpha$<br>(1/K)<br>$\times 10^{-6}$ | Thermal conductivity*<br>$\kappa$<br>(W/mK) | Specific heat*<br>$C_p$<br>(J/kg · K) | Bending strength*<br>$\delta b3$<br>(N/m <sup>2</sup> )<br>$\times 10^7$ | Young's modulus*<br>$E$<br>(N/m <sup>2</sup> )<br>$\times 10^{11}$ | Magnetostriction*<br>$\lambda_s$<br>$\times 10^{-6}$ |
|----------|----------------------------------|------------------------------------|--------------------------------------------------------------------------|-------|-----------------------------------------|-----------------------------------|--------------------------------------------------------------------|--------------|--------------|------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------|---------------------------------------------|---------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------|
|          | 23°C                             |                                    | 23°C                                                                     | 100°C | 23°C                                    | 23°C                              | 25kHz<br>90°C                                                      | 100kHz<br>80 | 100°C<br>520 |                                                                  |                                                                            |                                                                         |                                             |                                       |                                                                          |                                                                    |                                                      |
| PE22     | 1800                             | >200                               | 510                                                                      | 410   | 140                                     | 16                                | 79                                                                 | 80           | 520          | 3.0                                                              | 4.8                                                                        | 12                                                                      | 5                                           | 800                                   | 9                                                                        | 1.2                                                                | -0.6                                                 |
| PC40     | 2300                             | >200                               | 500                                                                      | 380   | 125                                     | 15                                | 64                                                                 | 70           | 420          | 6.5                                                              | 4.8                                                                        | 12                                                                      | 5                                           | 800                                   | 9                                                                        | 1.2                                                                | -0.6                                                 |

\* Typ.

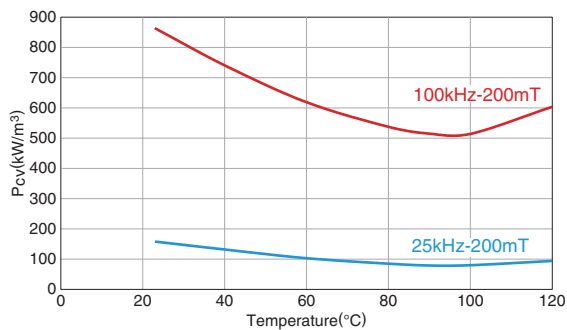
Mn-Zn Large size ferrite for high power **Material list of PE22**

## ■ MATERIAL CHARACTERISTICS

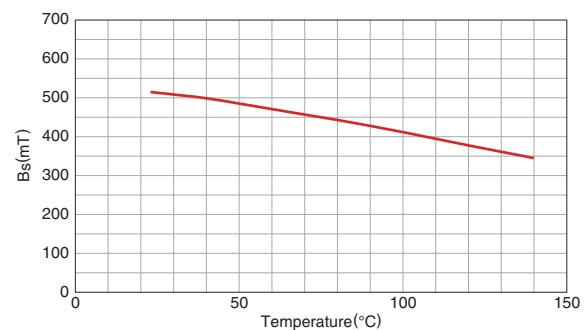
| Initial permeability* | Curie temperature | Saturation magnetic flux density* |       | Remanent flux density* | Coercive force* | Core loss*                                  |      |       | Electrical resistivity*        | Approximate density*                               | Thermal expansion coefficient*        | Thermal conductivity* | Specific heat*      | Bending strength*                                    | Young's modulus*                               | Magnetostriction*               |
|-----------------------|-------------------|-----------------------------------|-------|------------------------|-----------------|---------------------------------------------|------|-------|--------------------------------|----------------------------------------------------|---------------------------------------|-----------------------|---------------------|------------------------------------------------------|------------------------------------------------|---------------------------------|
| $\mu_i$               | $T_c$<br>(°C)     | $B_s$<br>(mT)<br>H=1194A/m        |       | $B_r$<br>(mT)          | $H_c$<br>(A/m)  | $P_{cv}$<br>(kW/m <sup>3</sup> )<br>B=200mT |      |       | $\rho$<br>( $\Omega \cdot m$ ) | $d_{app}$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | $\alpha$<br>(1/K)<br>$\times 10^{-6}$ | $\kappa$<br>(W/mK)    | $C_p$<br>(J/kg · K) | $\delta b_3$<br>(N/m <sup>2</sup> )<br>$\times 10^7$ | $E$<br>(N/m <sup>2</sup> )<br>$\times 10^{11}$ | $\lambda_s$<br>$\times 10^{-6}$ |
| 23°C                  |                   | 23°C                              | 100°C | 23°C                   | 23°C            | 25kHz                                       | 90°C | 100°C | 100kHz                         |                                                    |                                       |                       |                     |                                                      |                                                |                                 |
| 1800                  | >200              | 510                               | 410   | 140                    | 16              | 79                                          | 80   | 520   | 3.0                            | 4.8                                                | 12                                    | 5                     | 800                 | 9                                                    | 1.2                                            | -0.6                            |

\* Typ.

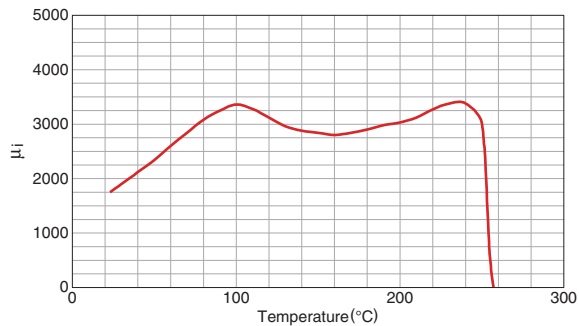
## □ Core loss vs. temperature characteristics (Typ.)



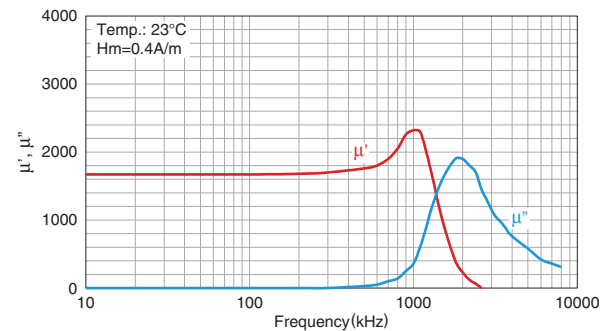
## □ Saturation magnetic flux density vs. temperature characteristics (Typ.)



## □ Initial magnetic permeability vs. temperature characteristics (Typ.)

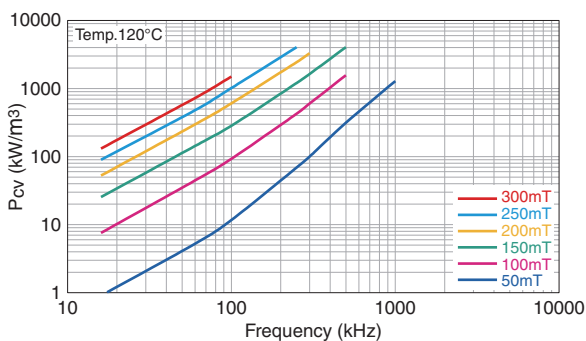
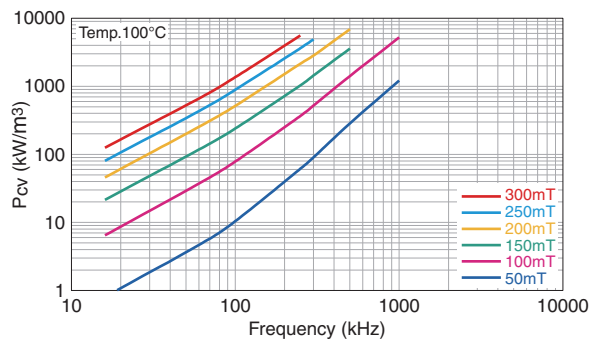
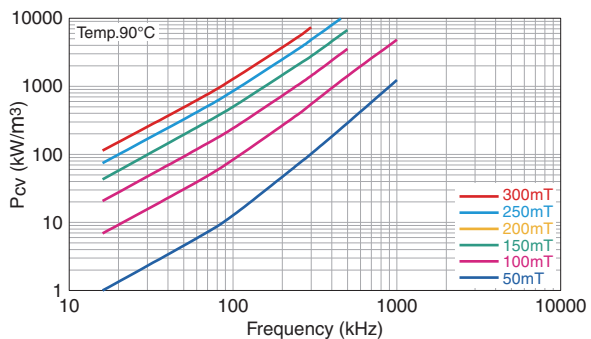
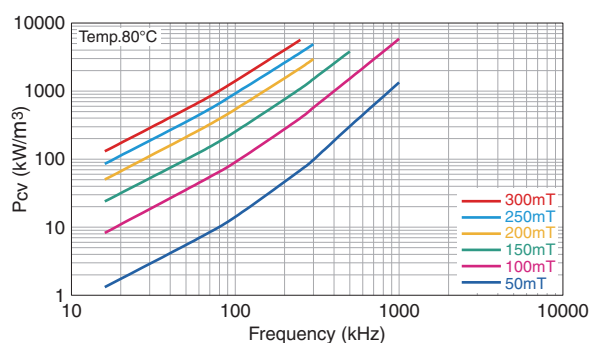
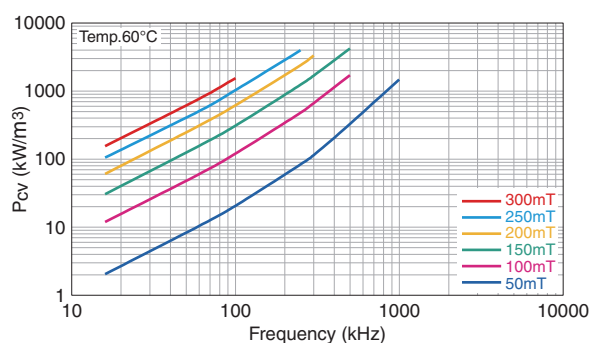
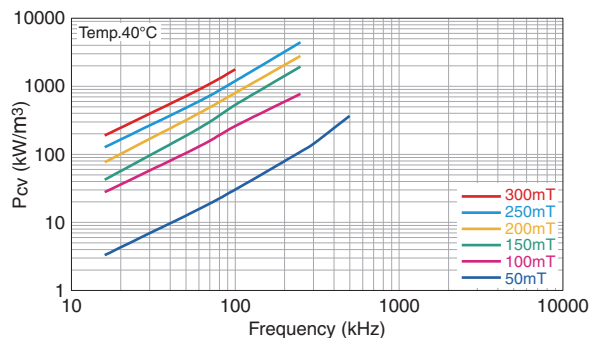
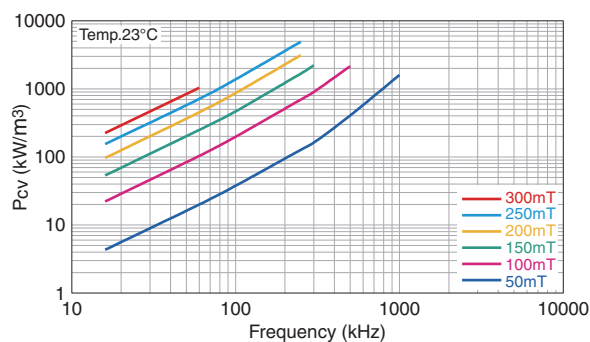


## □ Magnetic permeability vs. frequency characteristics (Typ.)



# Mn-Zn Large size ferrite for high power **Material list of PE22**

## Core loss vs. frequency characteristics



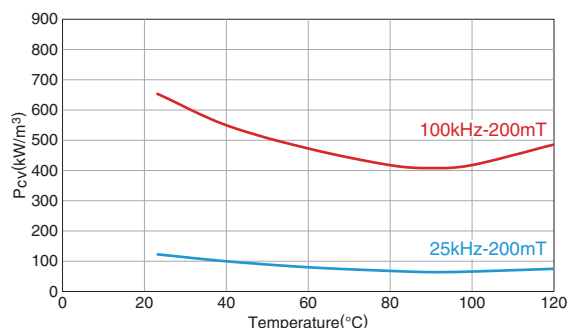
Mn-Zn Large size ferrite for high power **Material list of PC40**

## ■ MATERIAL CHARACTERISTICS

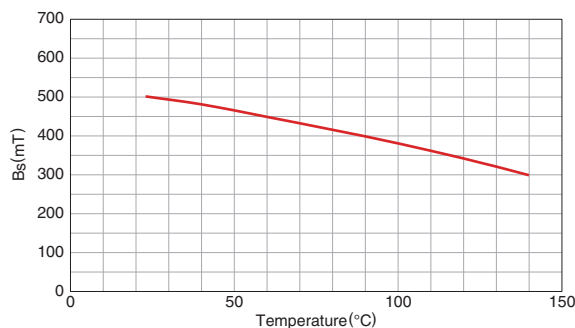
| Initial permeability* | Curie temperature | Saturation magnetic flux density* |       | Remanent flux density* | Coercive force* | Core loss*                                  |    |        | Electrical resistivity*        | Approximate density*                               | Thermal expansion coefficient*        | Thermal conductivity* | Specific heat*      | Bending strength*                                    | Young's modulus*                               | Magnetostriction*               |
|-----------------------|-------------------|-----------------------------------|-------|------------------------|-----------------|---------------------------------------------|----|--------|--------------------------------|----------------------------------------------------|---------------------------------------|-----------------------|---------------------|------------------------------------------------------|------------------------------------------------|---------------------------------|
| $\mu_i$               | $T_c$<br>(°C)     | $B_s$<br>(mT)<br>H=1194A/m        |       | $B_r$<br>(mT)          | $H_c$<br>(A/m)  | $P_{cv}$<br>(kW/m <sup>3</sup> )<br>B=200mT |    |        | $\rho$<br>( $\Omega \cdot m$ ) | $d_{app}$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | $\alpha$<br>(1/K)<br>$\times 10^{-6}$ | $\kappa$<br>(W/mK)    | $C_p$<br>(J/kg · K) | $\delta b_3$<br>(N/m <sup>2</sup> )<br>$\times 10^7$ | $E$<br>(N/m <sup>2</sup> )<br>$\times 10^{11}$ | $\lambda_s$<br>$\times 10^{-6}$ |
| 23°C                  |                   | 23°C                              | 100°C | 23°C                   | 23°C            | 25kHz                                       |    | 100kHz |                                |                                                    |                                       |                       |                     |                                                      |                                                |                                 |
| 2300                  | >200              | 500                               | 380   | 125                    | 15              | 64                                          | 70 | 420    | 6.5                            | 4.8                                                | 12                                    | 5                     | 800                 | 9                                                    | 1.2                                            | -0.6                            |

\* Typ.

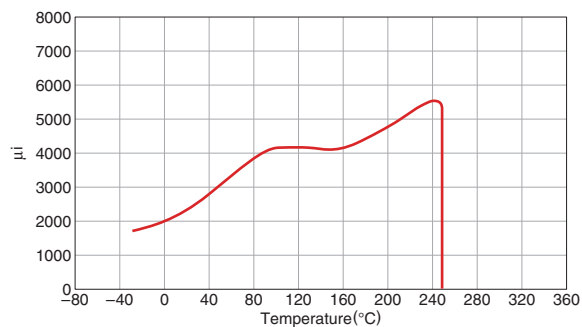
## □ Core loss vs. temperature characteristics (Typ.)



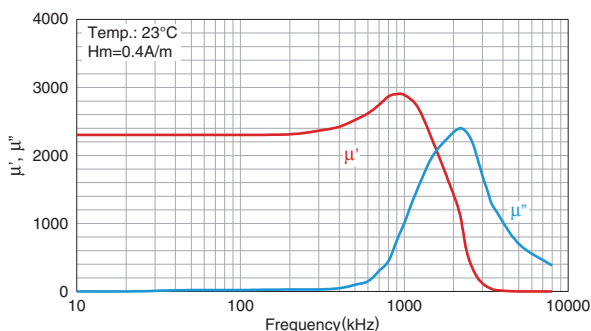
## □ Saturation magnetic flux density vs. temperature characteristics (Typ.)



## □ Initial magnetic permeability vs. temperature characteristics (Typ.)

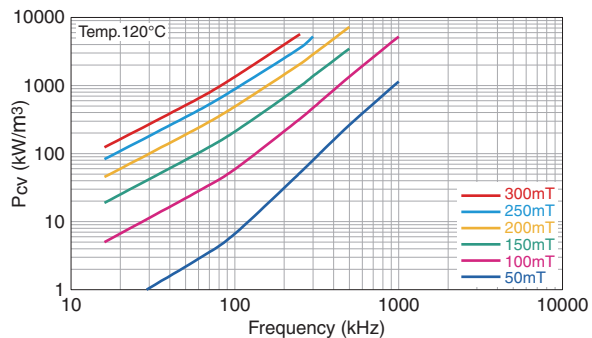
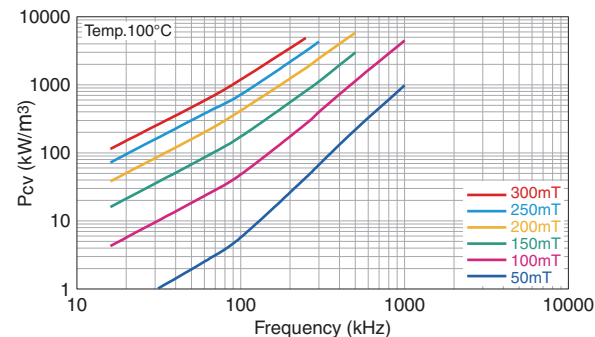
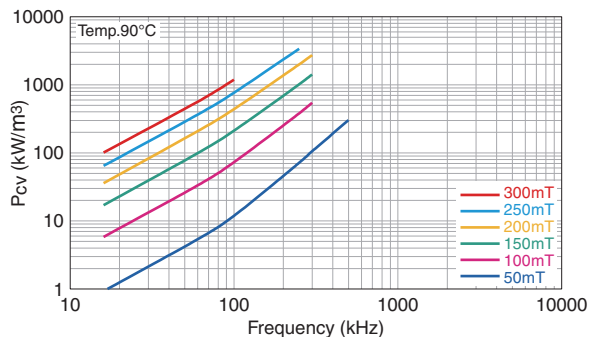
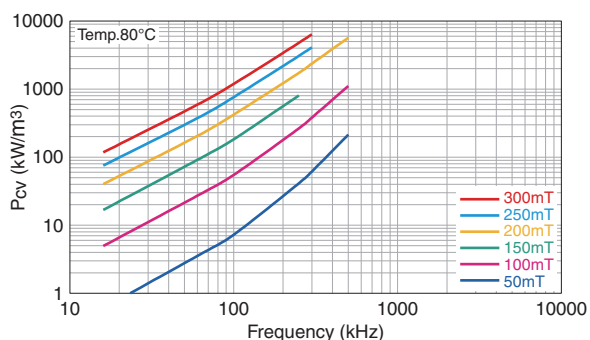
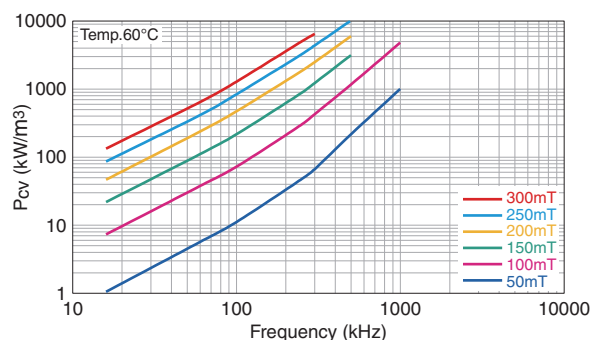
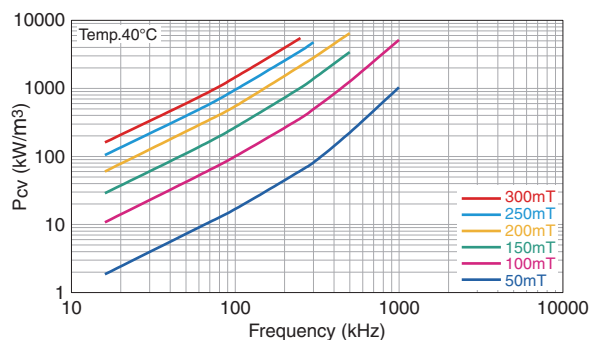
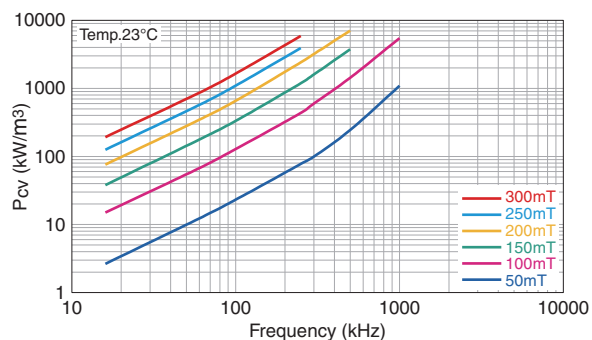


## □ Magnetic permeability vs. frequency characteristics (Typ.)



# Mn-Zn Large size ferrite for high power **Material list of PC40**

## Core loss vs. frequency characteristics



# FERRITES



## Mn-Zn Material list of ferrite core for telecommunication

### MATERIAL CHARACTERISTICS

| Material | Initial permeability<br>$\mu_i$     | Relative loss factor<br>$\tan\delta/\mu_i$<br>$\times 10^{-6}$ | Temperature factor of initial permeability<br>$\alpha_{\mu i r}$<br>$\times 10^{-6}$<br>-30 to +20°C<br>0 to 20°C<br>20 to 70°C | Saturation magnetic flux density*<br>$B_s$<br>(mT)<br>$H=1194\text{A/m}$<br>25°C | Residual flux density*<br>$B_r$<br>(mT)<br>25°C | Coercive force*<br>$H_c$<br>(A/m)<br>25°C | Curie temperature<br>$T_c$<br>(°C) | Hysteresis material constant<br>$\eta B$<br>$\frac{10^{-6}}{\text{mT}}$ | Disaccommodation factor<br>$DF$<br>$\times 10^{-6}$ | Density*<br>$d_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | Electrical resistivity*<br>$\rho_v$<br>( $\Omega \cdot \text{m}$ ) |
|----------|-------------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------|-------------------------------------------|------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------------|
| H5A      | 3300 <sup>+40%</sup> <sub>-0%</sub> | <2.5(10kHz)<br><10(100kHz)                                     | -0.5 to 2.0<br>—<br>-0.5 to 2.0                                                                                                 | 410                                                                              | 100                                             | 8.0                                       | >130                               | <0.8                                                                    | <3                                                  | 4.8                                                        | 1                                                                  |
| H5B2     | 7500±25%                            | <6.5(10kHz)                                                    | 0 to 1.8<br>—<br>0 to 1.8                                                                                                       | 420                                                                              | 40                                              | 5.6                                       | >130                               | <1.0                                                                    | <3                                                  | 4.9                                                        | 0.1                                                                |
| H5C2     | 10000±30%                           | <7.0(10kHz)                                                    | -0.5 to 1.5<br>—<br>-0.5 to 1.5                                                                                                 | 400                                                                              | 90                                              | 7.2                                       | >120                               | <1.4                                                                    | <2                                                  | 4.9                                                        | 0.15                                                               |
| H5C3     | 15000±30%                           | <7.0(10kHz)                                                    | -0.5 to 1.5<br>—<br>-0.5 to 1.5                                                                                                 | 360                                                                              | 105                                             | 4.4                                       | >105                               | <0.5                                                                    | <2                                                  | 4.95                                                       | 0.15                                                               |
| HP5      | 5000±20%                            | <3.5                                                           | —<br>±12.5%<br>±12.5%                                                                                                           | 400                                                                              | 65                                              | 7.2                                       | >140                               | <0.4                                                                    | <3                                                  | 4.8                                                        | 0.15                                                               |

\* Typ.

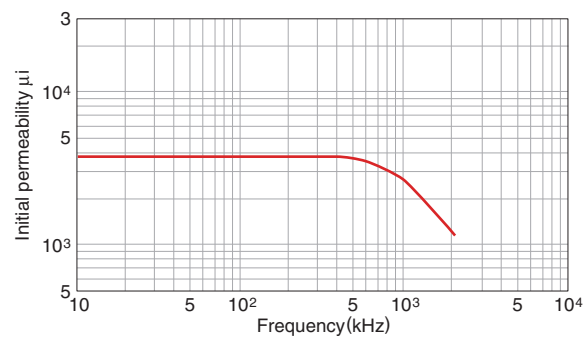
# Mn-Zn Ferrite for telecommunication **Material list of H5A**

## MATERIAL CHARACTERISTICS

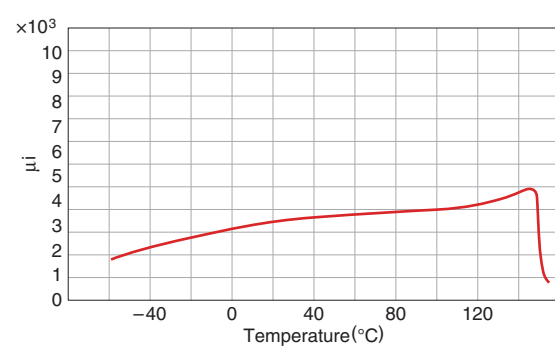
| Initial permeability | Relative loss factor                   | Temperature factor of initial permeability                                        | Saturation magnetic flux density*  | Residual flux density* | Coercive force*        | Curie temperature | Hysteresis material constant     | Disaccommodation factor  | Density*                                          | Electrical resistivity* |
|----------------------|----------------------------------------|-----------------------------------------------------------------------------------|------------------------------------|------------------------|------------------------|-------------------|----------------------------------|--------------------------|---------------------------------------------------|-------------------------|
| $\mu_i$              | $\tan\delta/\mu_i$<br>$\times 10^{-6}$ | $\alpha_{\mu i r}$<br>$\times 10^{-6}$<br>-30 to +20°C<br>0 to 20°C<br>20 to 70°C | $B_s$<br>(mT)<br>H=1194A/m<br>25°C | $B_r$<br>(mT)<br>25°C  | $H_c$<br>(A/m)<br>25°C | $T_c$<br>(°C)     | $\eta B$<br>$\frac{10^{-6}}{mT}$ | $DF$<br>$\times 10^{-6}$ | $\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | $\rho_v$<br>(Ω • m)     |
| 3300<br>+40%<br>-0%  | <2.5(10kHz)<br><10(100kHz)             | -0.5 to 2.0<br>—<br>-0.5 to 2.0                                                   | 410                                | 100                    | 8.0                    | >130              | <0.8                             | <3                       | 4.8                                               | 1                       |

\* Typ.

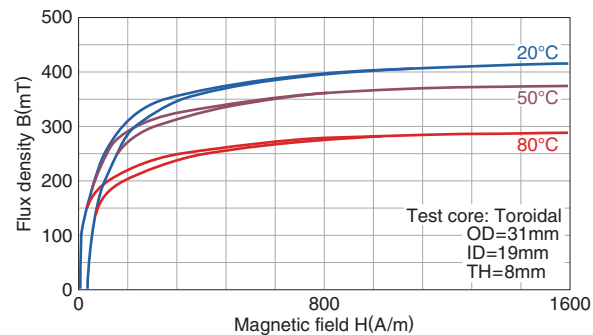
### □ $\mu_i$ frequency characteristics (Typ.)



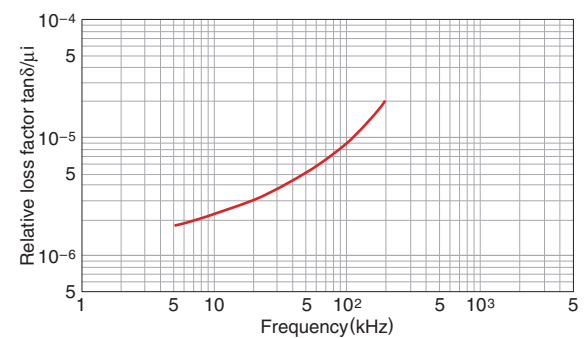
### □ $\mu_i$ temperature characteristics (Typ.)



### □ B-H temperature characteristics (Typ.)



### □ $\tan\delta/\mu_i$ frequency characteristics (Typ.)



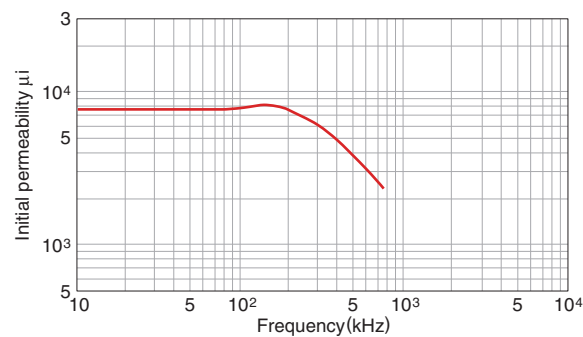
# Mn-Zn Ferrite for telecommunication Material list of H5B2

## MATERIAL CHARACTERISTICS

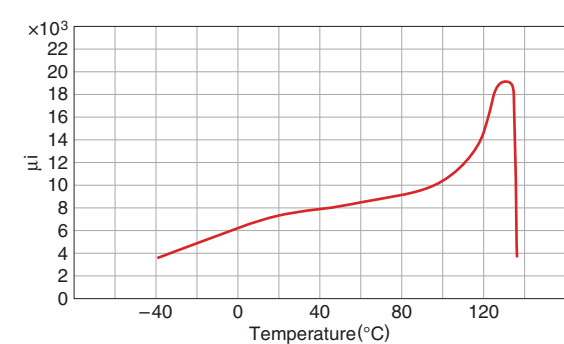
| Initial permeability | Relative loss factor                   | Temperature factor of initial permeability                                        | Saturation magnetic flux density*  | Residual flux density* | Coercive force*        | Curie temperature | Hysteresis material constant     | Disaccommodation factor  | Density*                                          | Electrical resistivity* |
|----------------------|----------------------------------------|-----------------------------------------------------------------------------------|------------------------------------|------------------------|------------------------|-------------------|----------------------------------|--------------------------|---------------------------------------------------|-------------------------|
| $\mu_i$              | $\tan\delta/\mu_i$<br>$\times 10^{-6}$ | $\alpha_{\mu i r}$<br>$\times 10^{-6}$<br>-30 to +20°C<br>0 to 20°C<br>20 to 70°C | $B_s$<br>(mT)<br>H=1194A/m<br>25°C | $B_r$<br>(mT)<br>25°C  | $H_c$<br>(A/m)<br>25°C | $T_c$<br>(°C)     | $\eta B$<br>$\frac{10^{-6}}{mT}$ | $DF$<br>$\times 10^{-6}$ | $\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | $\rho_v$<br>(Ω • m)     |
| 7500±25%             | <6.5(10kHz)                            | 0 to 1.8<br>—<br>0 to 1.8                                                         | 420                                | 40                     | 5.6                    | >130              | <1.0                             | <3                       | 4.9                                               | 0.1                     |

\* Typ.

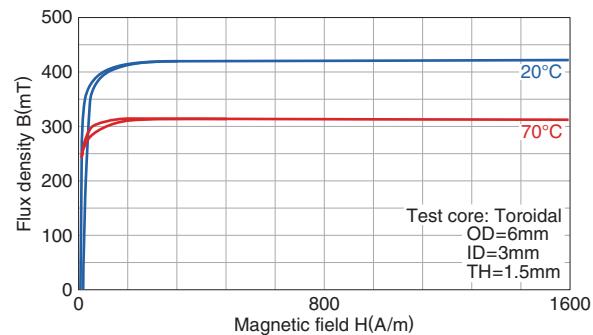
### $\mu_i$ frequency characteristics (Typ.)



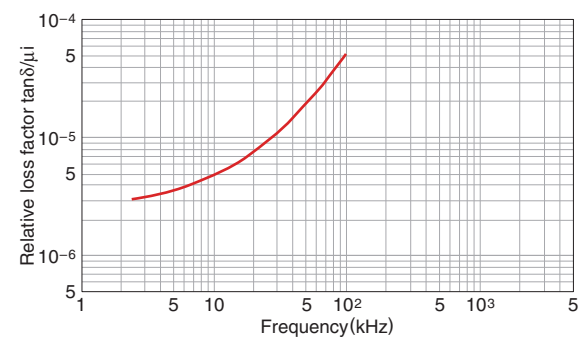
### $\mu_i$ temperature characteristics (Typ.)



### B-H temperature characteristics (Typ.)



### $\tan\delta/\mu_i$ frequency characteristics (Typ.)



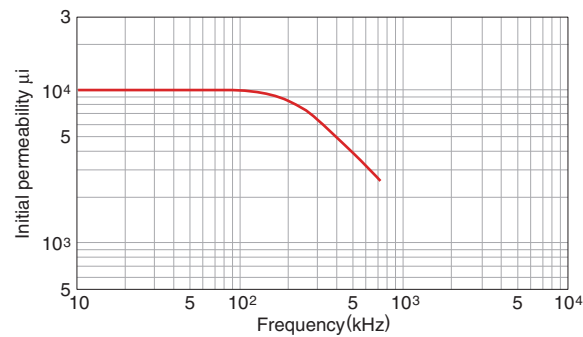
# Mn-Zn Ferrite for telecommunication Material list of H5C2

## MATERIAL CHARACTERISTICS

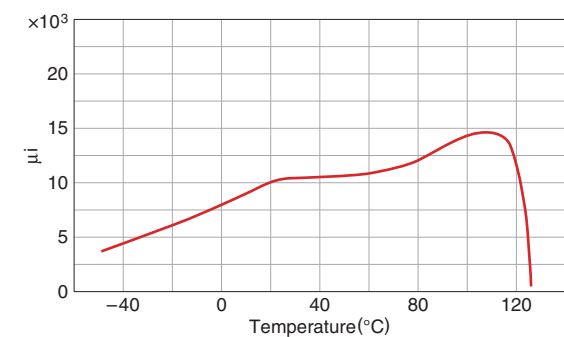
| Initial permeability | Relative loss factor                   | Temperature factor of initial permeability                                        | Saturation magnetic flux density*  | Residual flux density* | Coercive force*        | Curie temperature | Hysteresis material constant            | Disaccommodation factor  | Density*                                          | Electrical resistivity*                 |
|----------------------|----------------------------------------|-----------------------------------------------------------------------------------|------------------------------------|------------------------|------------------------|-------------------|-----------------------------------------|--------------------------|---------------------------------------------------|-----------------------------------------|
| $\mu_i$              | $\tan\delta/\mu_i$<br>$\times 10^{-6}$ | $\alpha_{\mu i r}$<br>$\times 10^{-6}$<br>-30 to +20°C<br>0 to 20°C<br>20 to 70°C | $B_s$<br>(mT)<br>H=1194A/m<br>25°C | $B_r$<br>(mT)<br>25°C  | $H_c$<br>(A/m)<br>25°C | $T_c$<br>(°C)     | $\eta B$<br>$\frac{10^{-6}}{\text{mT}}$ | $DF$<br>$\times 10^{-6}$ | $\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | $\rho_v$<br>( $\Omega \cdot \text{m}$ ) |
| 10000±30%            | <7.0(10kHz)                            | -0.5 to 1.5<br>—<br>-0.5 to 1.5                                                   | 400                                | 90                     | 7.2                    | >120              | <1.4                                    | <2                       | 4.9                                               | 0.15                                    |

\* Typ.

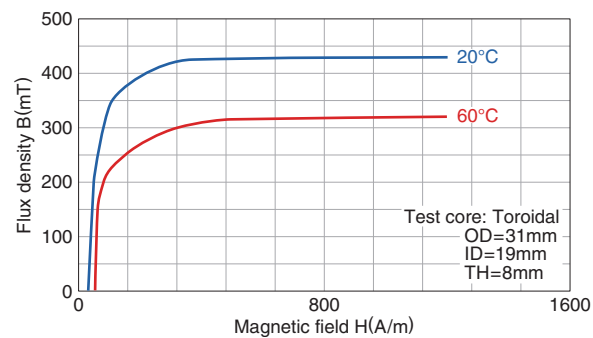
### $\mu_i$ frequency characteristics (Typ.)



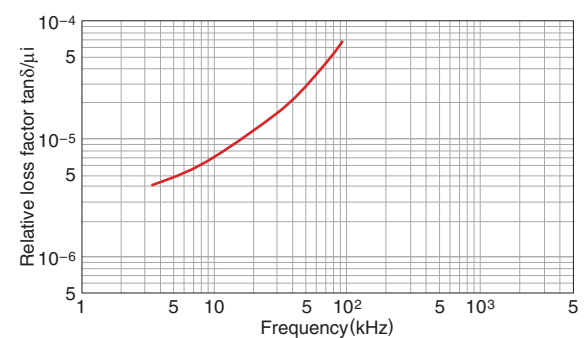
### $\mu_i$ temperature characteristics (Typ.)



### B-H temperature characteristics (Typ.)



### $\tan\delta/\mu_i$ frequency characteristics (Typ.)



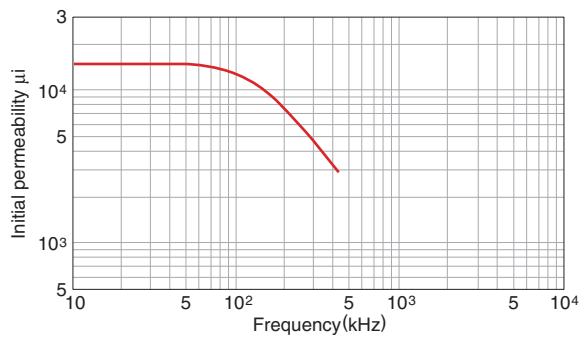
# Mn-Zn Ferrite for telecommunication Material list of H5C3

## MATERIAL CHARACTERISTICS

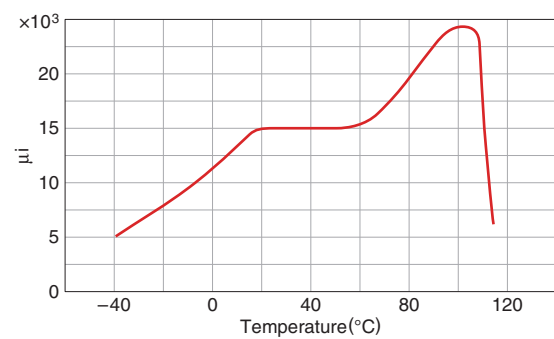
| Initial permeability | Relative loss factor                   | Temperature factor of initial permeability                                        | Saturation magnetic flux density*           | Residual flux density*         | Coercive force*                 | Curie temperature      | Hysteresis material constant            | Disaccommodation factor | Density*                                    | Electrical resistivity* |
|----------------------|----------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------|--------------------------------|---------------------------------|------------------------|-----------------------------------------|-------------------------|---------------------------------------------|-------------------------|
| $\mu_i$              | $\tan\delta/\mu_i$<br>$\times 10^{-6}$ | $\alpha_{\mu i r}$<br>$\times 10^{-6}$<br>-30 to +20°C<br>0 to 20°C<br>20 to 70°C | B <sub>s</sub><br>(mT)<br>H=1194A/m<br>25°C | B <sub>r</sub><br>(mT)<br>25°C | H <sub>c</sub><br>(A/m)<br>25°C | T <sub>c</sub><br>(°C) | $\eta B$<br>$\frac{10^{-6}}{\text{mT}}$ | DF<br>$\times 10^{-6}$  | db<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | $\rho_v$<br>(Ω • m)     |
| 15000±30%            | <7.0(10kHz)                            | -0.5 to 1.5<br>—<br>-0.5 to 1.5                                                   | 360                                         | 105                            | 4.4                             | >105                   | <0.5                                    | <2                      | 4.95                                        | 0.15                    |

\* Typ.

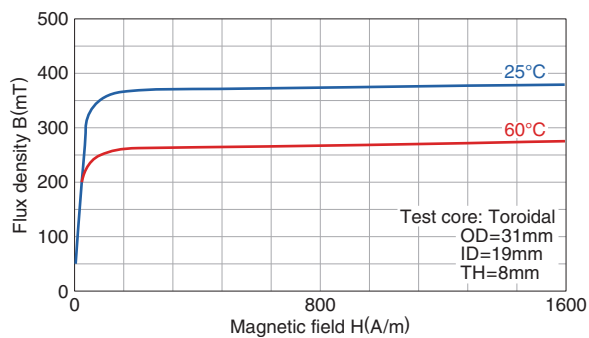
### $\mu_i$ frequency characteristics (Typ.)



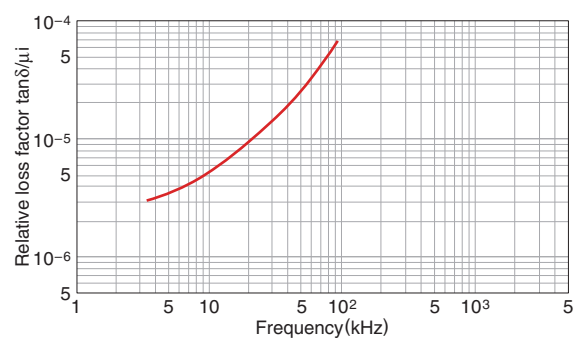
### $\mu_i$ temperature characteristics (Typ.)



### B-H temperature characteristics (Typ.)



### $\tan\delta/\mu_i$ frequency characteristics (Typ.)



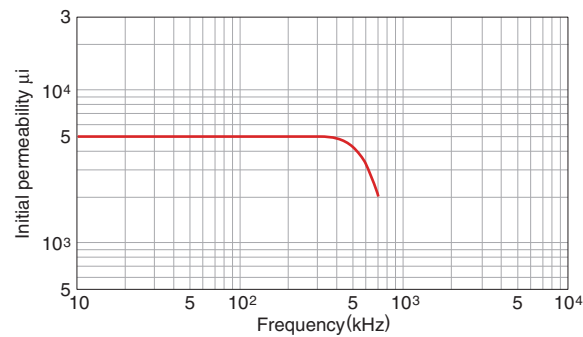
# Mn-Zn Ferrite for telecommunication Material list of HP5

## MATERIAL CHARACTERISTICS

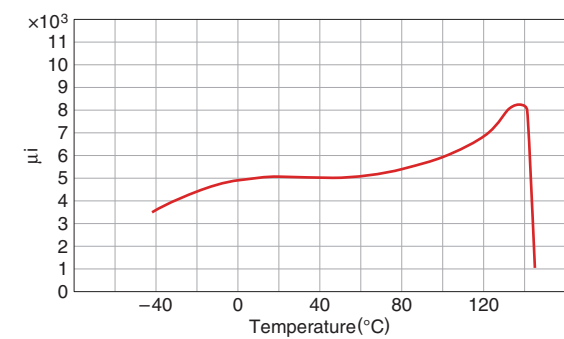
| Initial permeability | Relative loss factor                   | Temperature factor of initial permeability                                        | Saturation magnetic flux density*  | Residual flux density* | Coercive force*        | Curie temperature | Hysteresis material constant            | Disaccommodation factor  | Density*                                          | Electrical resistivity*                 |
|----------------------|----------------------------------------|-----------------------------------------------------------------------------------|------------------------------------|------------------------|------------------------|-------------------|-----------------------------------------|--------------------------|---------------------------------------------------|-----------------------------------------|
| $\mu_i$              | $\tan\delta/\mu_i$<br>$\times 10^{-6}$ | $\alpha_{\mu i r}$<br>$\times 10^{-6}$<br>-30 to +20°C<br>0 to 20°C<br>20 to 70°C | $B_s$<br>(mT)<br>H=1194A/m<br>25°C | $B_r$<br>(mT)<br>25°C  | $H_c$<br>(A/m)<br>25°C | $T_c$<br>(°C)     | $\eta B$<br>$\frac{10^{-6}}{\text{mT}}$ | $DF$<br>$\times 10^{-6}$ | $\rho_b$<br>(kg/m <sup>3</sup> )<br>$\times 10^3$ | $\rho_v$<br>( $\Omega \cdot \text{m}$ ) |
| 5000±20%             | <3.5                                   | —<br>±12.5%<br>±12.5%                                                             | 400                                | 65                     | 7.2                    | >140              | <0.4                                    | <3                       | 4.8                                               | 0.15                                    |

\* Typ.

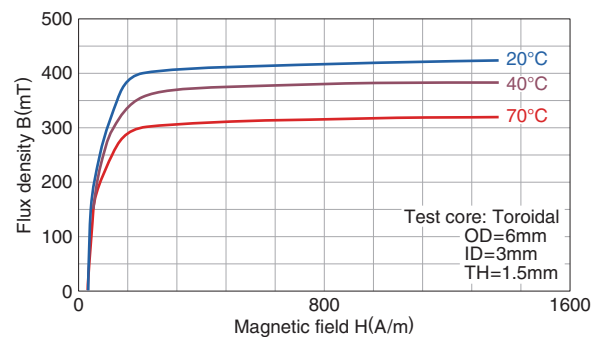
### $\mu_i$ frequency characteristics (Typ.)



### $\mu_i$ temperature characteristics (Typ.)



### B-H temperature characteristics (Typ.)



### $\tan\delta/\mu_i$ frequency characteristics (Typ.)

